Office of Technical Assistance
Executive Office of Environmental Affairs
Commonwealth of Massachusetts

Toxics Use Reduction Case Study

HAMPDEN PAPERS REDUCES WASTEWATER BY 80 PERCENT, ENDS EXCESSIVE ZINC DISCHARGE

SUMMARY

Despite earlier reductions, wastewater discharges from Hampden Papers specialty printing operations continued to contain zinc and copper levels above the discharge limits set by the local wastewater treatment authority. The company, the Office of Technical Assistance for Toxics Use Reduction and the regulatory authority worked together cooperatively and, without installing a very expensive treatment system, have succeeded in:

- reducing zinc discharge — by January 1, 1995, annual zinc use will be 6,000 pounds, 30 percent of the previous level
- identifying a number of potential alternatives to reduce copper discharge
- reducing wastewater discharges by 80 percent from an average of 80,000 gallons per day to an average daily production discharge of 12,000 gallons per day — less than one half the 25,000 gallon permitting threshold.

BACKGROUND

Hampden Papers, Inc., a 114-year-old specialty manufacturer of converted paper, film, foils and boards, employs 180 workers and has 64 production machines at its 300,000 square foot factory in Holyoke, Massachusetts. The company's printed, coated, embossed and laminated products range from gift wrapping paper to foil liners for premium chocolates and are sold in more than 80 markets. The City of Holyoke publicly owned treatment works (POTW) sets loadings parameters for Significant Industrial User (SIU) permits for companies with wastewater discharges that average over 25,000 gallons per day (gpd). Discharges exceeding the established limits — 2.32 parts per million (ppm) for zinc and 1.32 ppm for copper — face local and U.S. EPA enforcement action.

THE PROBLEM

Hampden generates wastewater discharges from its printing machines, the coating mixing area and kettle washup. The company's monitoring data show that zinc discharges regularly exceeded permit limits and that copper also did, though less often. Continued excessive discharges could have forced the POTW to mandate installation of treatment technology costing $250,000 to $500,000.

Jim Fleming, manager of the POTW, opted instead to refer Hampden to OTA to seek assistance in eliminating the problem at the source. Ken Scott, vice president of research and development, contacted OTA and waived Hampden's right to confidentiality so that the company, OTA and the regulatory agency (the POTW) could work together. Fleming and Dan Donovan, the POTW pretreatment inspector, followed progress and offered suggestions at periodic update meetings with Hampden.

OTA Case Studies about Hampden's earlier experiences with pollution prevention described:

- a gradual conversion over the years 1981 to 1989 to water based coatings, which reduced solvent use by 96 percent
- substitution, in April 1992, of a mica-based coating for a brass-based coating, which had contributed copper and zinc to the POTW's sludge at levels that made it unusable for agricultural applications. Sludge that tests above allowable limits had to be sent to a hazardous waste landfill.

THE RESEARCH

The new project, to further reduce both zinc and copper loadings and overall wastewater discharges, was conducted in stages. OTA and Hampden first concentrated on zinc discharges, and then examined copper, which exceeded discharge limits less frequently. Finally, with encouragement from Vice President of Manufacturing Dick Wells and with Fleming's assistance, the company worked on reducing wastewater discharges below the SIU level.

Zinc and copper in Hampden's water discharges come from three sources: printing operations, coating mixing, and kettle cleanup. OTA examined each source and also tested the incoming water, which showed that zinc and copper were below detection levels. U.S. EPA's Lexington Laboratory performed the analyses using X-ray spectrophotography capable of detecting concentrations greater than 20 ppm.

Discharges from the coating mixing area came from spill cleanup; improved spill prevention was the appropriate pollution prevention method.

Hampden has nine machines that generate wastewater discharges: six gravure presses and three air knife coaters. Zinc ammonium carbonate (ZAC), present as a crosslinker which allows aqueous based ink and coating constituents to become waterproofed, is a component in 60 percent of Hampden's throughput and is used almost exclusively on the gravure presses. Copper, used as a pigment in blue and green ink dyes, is only rarely used on the gravure presses and overall is used for about three percent of Hampden production.

PHASE ONE: ZINC

Material safety data sheets (MSDSs) list hazardous constituents in products and are required by law to be available for products that contain them. Zinc only appears on the MSDSs for the products used on Hampden's gravure presses.

In gravure printing, ink is pumped from a kettle to an ink well and then onto a metal cylinder. During cleanup, which is now done with water, operators manually reclaim as much ink as possible for reuse. Four of Hampden's six gravure printing presses require less than five gallons each per cleanup, but the other two require 30 and 45 gallons of water respectively per cleanup. Sue Krawczyk, Hampden's senior chemical research technician, helped collect washwater from the six machines; analysis showed that the two high volume machines generated concentrations that would affect effluent concentrations. The operators reclaim most of the excess ink from the wells of all of the machines.

OTA and Hampden identified two possible alternatives to ZAC as well as an emerging production method that would use dispersion, rather than solution, technology. OTA also recommended reducing washup volumes, attempting to reclaim more of the unused ink, and further testing of washwater from kettle cleanup and incoming water sources.

One of the alternative chemicals was a carcinogen and was ruled out. The other chemical, ammonium zirconium carbonate (AZC), is more expensive than ZAC. In several trials over two months, AZC easily met discharge limits, but did not meet quality specifications and its use was discontinued. The dispersion technology, which became available for commercial application much sooner than originally expected, involves replacing an acrylic aqueous system with one which uses sulfonated polyesters. The dispersion system, though only applicable to certain coatings, is compatible with 85 percent of Hampden's total coatings needs. By March 1994 the company was using it for 20 percent of potential production. Hampden hopes to increase this to 70 percent by 1995.

PHASE TWO: COPPER

When OTA met with Hampden and the POTW to discuss OTA's recommendations for reducing zinc discharges, the group decided to initiate a similar analysis of the copper-based inks and their related discharges.

On the air knife coaters, water flowed at 7.5 gallons per minute for 60 to 90 minutes from unrestricted hoses used to clean the ink wells. The ink mixing kettles required 20 to 50 gallons of water per cleanup. Hampden mixes its custom colors in various size kettles, which need to be cleaned after each use — as often as a dozen times a day. Lack of flow controls on the hoses used to clean the coaters led to high volumes of water discharge with copper concentrations which were below detection level only because of the dilution. The washwater from kettles with large amounts of residual ink contained high concentrations of the metal.

Samples of colors and carriers were also tested for zinc and copper content; one sample of an ink carrier used on an air knife coater indicated zinc, which is not listed on the MSDS. The maker of the carrier said that zinc is present, but below the reporting threshold.

OTA has not identified any substitutes for copper as a pigment and suggested segregated wastewater treatment as a possible solution since copper pigment is only used in three percent of Hampden's production. OTA also suggested:

- water conservation through improved cleaning practices and flow restrictors, and containment, treatment and recycling of the remaining discharges
- training workers to remove as much ink as possible from machines and kettles before wet cleaning

Jim Fleming, of the POTW, recommended water conservation noting that sewer discharges peaked as high as 130,000 gpd and even on non-production days were as high as 8,000 gallons. Fleming felt that Hampden could reduce its discharges to below 25,000 gpd, and that this, combined with reduced zinc and copper in the effluent, would remove Hampden from the SIU list, thus eliminating any need for EPA enforcement action. As a short term solution, ending SIU status would give Hampden time to implement procedures to reduce zinc and copper discharges.

PHASE THREE: WATER CONSERVATION

Dick Wells, the vice president of manufacturing, had followed the AZC trials and, while wary of the effect new methods can have on quality, worked with Ken Scott, the vice president of research and manufacturing, to reduce water discharges.

Scott instructed the maintenance department to locate and close all leaking hoses and faucets and to install automatic shutoffs on toilets, sinks and hoses. He also used a recently prepared piping diagram of the facility to locate air conditioning and machinery cooling lines and divert noncontact cooling water discharges from the sewer line to a nearby river instead. The cumulative effect of these efforts surprised management — average production day discharge is now 12,000 gallons and nonproduction day flow is zero. The POTW has removed Hampden from the SIU list, provided that the company continues to seek substitute chemicals and implement improved cleanup practices.

OBSERVATIONS

Hampden's experience with AZC substitution trials might have been due to a bad batch of chemical, but it left the employees skeptical about new methods. Hampden recognizes that more employee involvement in the planning stages might have led to more "buy in" to the need for source reduction and willingness to try to make the change a success. The successive failures also indicate the need to pursue careful piloting before embarking on full implementation which can lead to poor product and loss of customer satisfaction.

The POTW staff provided valuable assistance and, backed up by the mandate of regulations, were able to encourage source reduction and contribute insight and advice as well as regulatory flexibility. The result

is an environmentally desirable outcome for the project: significant water conservation, little control technology and much less pollution.

Hampden Papers, in particular Ken Scott, Sue Krawczyk and Dick Wells, were especially important to this project. They, like Fleming, felt that source reduction would generate a solution. The people involved in the program needed to believe it would work. Hampden's research on zinc alternatives yielded two possible alternatives: AZC and dispersion technology. Though AZC failed, Hampden incorporated the lessons learned in that failure into the trials for new dispersion technology. In addition, Hampden successfully implemented a water conservation program that, had the dispersion technology not been identified, would have provided several years to plan and implement new methods for reducing zinc and copper discharges.

Hampden has made some remarkable achievements as a result of this project. Water discharge is less than 20 percent of 1993 average daily flow. Water losses due to open or leaking hoses, pipes and valves have been virtually eliminated. Scott expects that by 1995 zinc use will be reduced to 20 percent of previous levels. Both zinc and copper discharges have been reduced because of improved cleanup practices stemming from increased employee awareness.

Municipal flexibility instead of the threat of regulatory action made it possible to solve a pollution problem in a way that prevents or reduces hazardous waste generation and better protects the environment and has saved Hampden as much as $500,000 in potential costs for in-plant wastewater treatment. The regulatory agency was comfortable knowing that a schedule of pollution prevention milestones guaranteed steady progress toward the goal of achieving a sustainable end to unacceptable discharges. OTA prepared a timeline for implementation of pollution prevention procedures, the company agreed to the proposed schedule and the POTW approved to a *Compliance Schedule*, which through an innovative modification became a *"Pollution Prevention" Compliance Schedule.*